



Risk Assessment of Natural Gas Pipelines



**Arthur O'Donnell, Supervisor
Safety & Enforcement Division
Risk Assessment Section
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Mission Statement Risk Assessment Section

The Mission of the Safety & Enforcement Division's Risk Assessment section is to promote safety by ensuring that the regulated entities integrate risk assessment and risk management into their operational planning and other decision-making processes.





Elements of Risk

- The effect of uncertainty on objectives, Risk is often expressed in terms of a combination of the likelihood of adverse events and the associated event consequences (ISO Guide 73:2009).
- Determining Risk is not simply a formula – it is not easy to quantify either probability or consequence.
- Risk analysis is relatively new to utility rate regulation – although utilities are familiar with risk assessment for fuel costs and supply, operational hazards and financial risks.
- Our focus is on Safety and Reliability of utility operations.

Risk cannot be completely eliminated but it can be managed.





Integrating Risk into the Regulatory Framework

- Decision D.14-12-025 in CPUC Rulemaking R.13-11-006 provides a new framework for incorporating Safety Risk Assessment into General Rate Cases:
 - S-MAP - Safety Model Assessment Proceeding (A.15-05-002, et al.) is a first step toward reviewing IOU risk approaches and driving them toward consistency and more transparency. May 1 filings lead to consolidated proceeding to consider best approaches.
 - RAMP - Risk Assessment Methodology Phase of each GRC will present a prioritization of operational and asset risks, proposed mitigations and estimates of costs to reduce risk to acceptable levels for consideration within GRCs
 - Annual verification reports will follow GRC approvals
 - Risk Spending Accountability Report – did IOU spend as directed?
 - Risk Mitigation Accountability Report – what results were achieved?





Other Forums for Considering Risk

- Preliminary consideration of utility risk management undertaken in prior and pending rate cases:
 - PG&E 2014 GRC
 - PG&E Gas Transmission & Storage
 - SoCal Edison 2015 GRC
 - SDG&E and SoCal Gas 2016 GRC
- Technical reports and whitepapers from SED Risk group:
 - Fracking in California
 - Aldyl-A plastic pipes
 - Methane Leak Abatement
 - As Low as Reasonably Practicable (ALARP) cost/benefit analysis
- Safety and risks consideration in all new proceedings





Why Do Risk Assessment?

- Provide better rationale for utility spending programs related to Safety & Reliability of operations;
- Provide a more reliable base of understanding for operations;
- Using risk assessment, an operator gets to know what can go wrong, how it can go wrong, where it can go wrong and how badly can it go wrong;
- With this knowledge the operator can plan accordingly for contingencies;
- The operator can more cost-effectively spend resources to mitigate potential risks (avoid likelihood or lessen severity) by spending more on mitigation where there is the most risk and most opportunity for improvement.





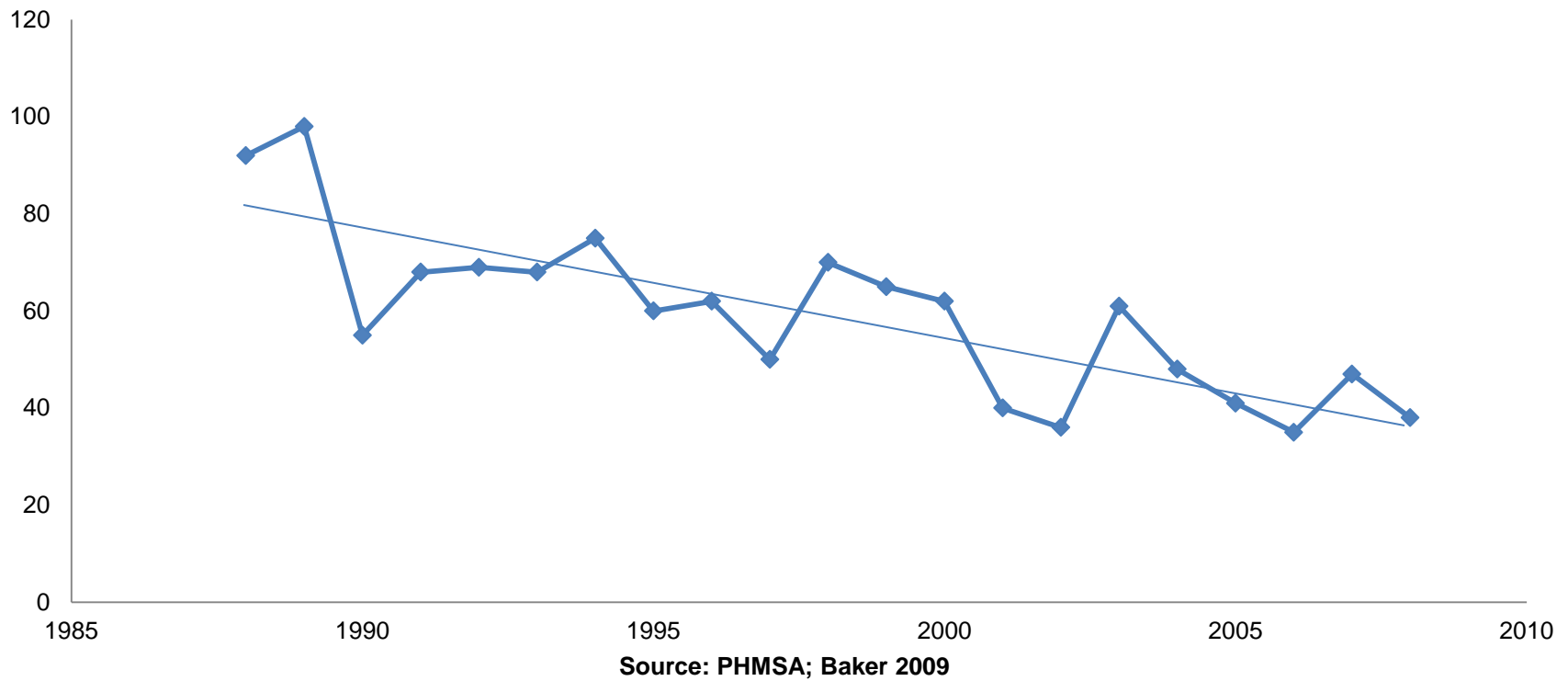
Gas Pipeline Risks





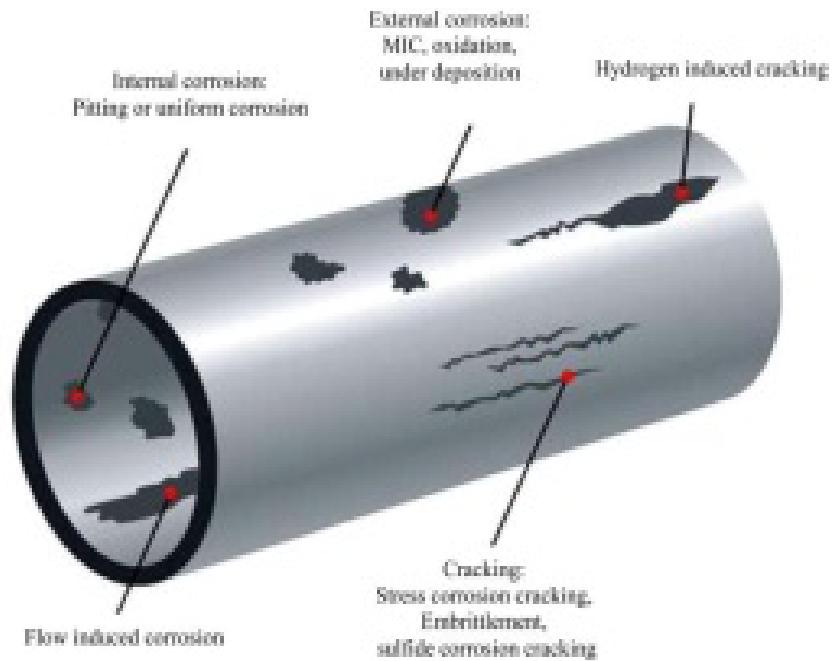
Gas Pipeline Risks

Serious Incidents All Causes Gas Pipelines 1988-2008





Gas Pipeline Risks



Source: ASME - Journal of Pressure
Vessel Technology





Gas Pipeline Risks

- Traditional focus on several major vectors:
 - Material Failure (faulty design or manufacture; faulty installation, welding or construction of facilities);
 - Corrosion – internal or external to pipe;
 - Excavation damage (dig-ins);
 - Human Error;
 - Natural Forces (i.e., ground movement);
 - Other.

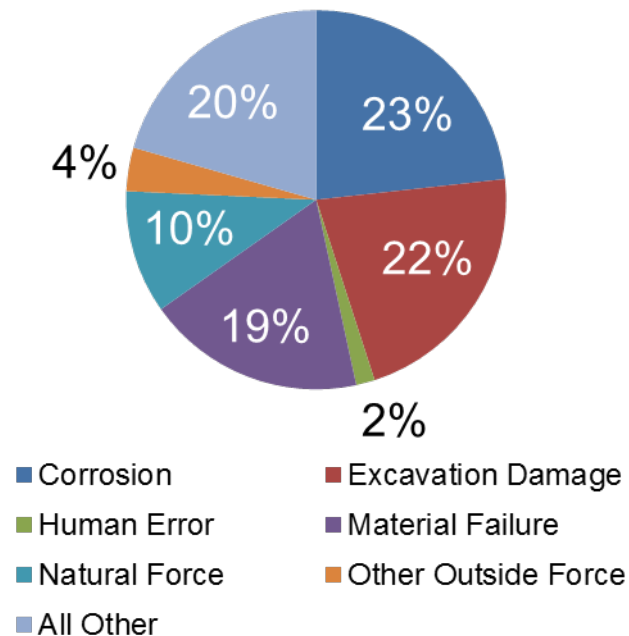




Gas Pipeline Risks

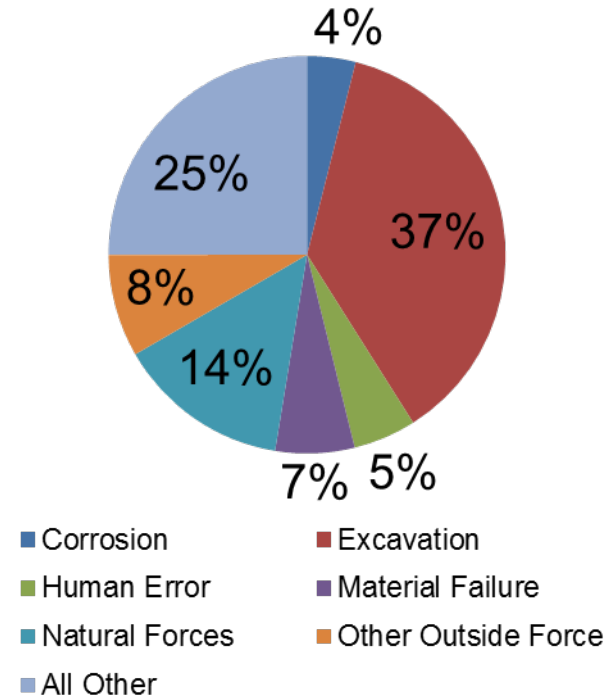
Significant Incidents 1988-2008

Transmission Systems



Significant Incidents 1988-2008

Distribution Systems



Source: National
Statistics PHMSA;
Baker 2008





Gas Pipeline Risks

- Since San Bruno pipeline explosion and other incidents, our understanding of Risk has broadened to include:
 - Lack of Safety Culture in utility management and/or agency
 - Poor or non-existent record-keeping
 - Inadequate surveying and/or testing
 - Operational practices (i.e., pressure controls)
 - Inadequate guidelines for contractors
 - Legalistic approach that treats Risk as a liability to be allocated to other parties via contracts
 - Misapplied incentives (reduce cost at expense of safety)
 - Inadequate resources for CPUC enforcement and auditing





Gas Pipeline Risks

Current California utility practice is to assess and rank operational and corporate risks using “relative risk scoring”

Simple example from SoCal Gas, in current General Rate Case:

Frequency of event on a 1 – 7 scale (1 extremely rare – 7 frequent)

Impact of consequence on a 1 – 7 scale (7 potentially catastrophic)

Impact (squared) + frequency (squared) = Risk score (sq)

$$I^2 + F^2 = IR^2$$

Inherent Risk score (1 – 10 scale) is square root of IR^2

Apply mitigations to reduce likelihood and/or severity = Residual Risk

Strength of mitigation (1 – 7 scale)

$$RI^2 + RF^2 = RR^2$$





Gas Pipeline Risks

Examples:

- Risk of pipeline failure resulting in injuries to public or property damage

Inherent Impact = 7

Inherent Frequency = 3

Inherent Risk = 7.6

Mitigations include: Integrity Management Programs, pipeline replacement, increased testing, comprehensive training, better systems to manage compliance activities.

Strength of Mitigation = 6* (assessment of how it reduces factors)

Residual Impact = 7

Residual Frequency = 2

Residual Risk = 7.3





Gas Pipeline Risks

- Cyber risk: a major security incident disrupts gas flow to customers

Inherent Impact = 7

Inherent Frequency = 5

Inherent Risk = 8.6

Mitigations include: Implement security strategy, better controls, better monitoring, awareness training, threat simulation, better coordination with industry & government

Strength of Mitigation = 5*

Residual Impact = 5

Residual Frequency = 4

Residual Risk = 6.4





Gas System Risks

Southern California Gas Company Major Risks (Residual):

See: Safety & Enforcement Division Staff Report on Consolidated General Rate Cases

- Disruption to gas system that impacts supply to customers – 7.8
- Pipeline failure that results in injuries or property damage – 7.3
- Supply/capacity issues to serve non-core Southern System – 7.2
- Damage to infrastructure by contactors or 3rd Parties – 7.2
- Cyber security event affecting gas flows to customers – 6.4
- Failure of recovery after natural disaster – 5.8

How does this translate into General Rate Case Request?





Risk Mitigation in GRC

Combined, SoCal Gas' and SDG&E's risk-related spending plans for natural gas is \$1.46 billion in capital for the three-year period 2016-18.

The requested O&M for both companies in TY 2016 totals \$391 million.

Over 85 percent of total capital request is attributed to reliability-related risk mitigation for the three-year period, and over 80 percent of the TY 2016 O&M request.

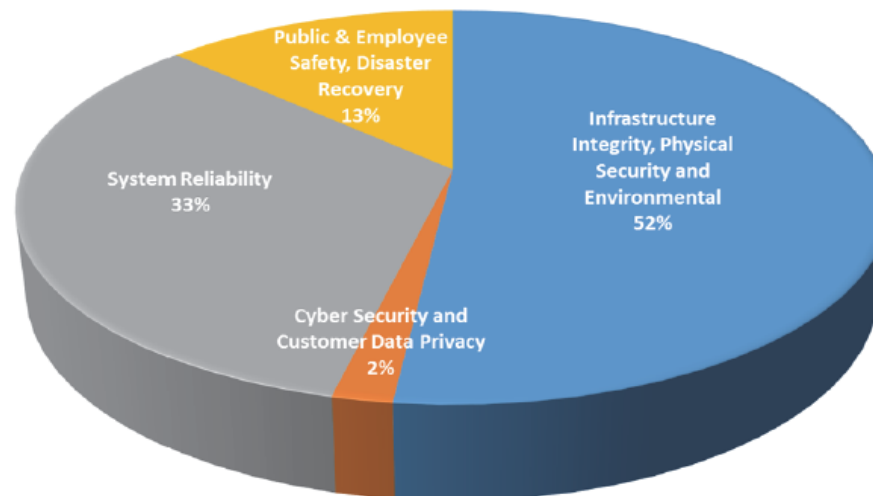
Source: A. 14-11-003/04 SDG&E & SoCal Gas GRC

Risk Category	Capital (\$ 000's)	O&M (\$ 000's)
Infrastructure Integrity, Physical Security and Environmental	\$757,015	\$204,410
Cyber Security and Customer Data Privacy	\$31,570	\$1,294
System Reliability	\$502,395	\$115,077
Public & Employee Safety, Disaster Recovery	\$171,274	\$71,312



SoCalGas and SDG&E Gas Risk Mitigation

- Infrastructure Integrity, Physical Security and Environmental
- Cyber Security and Customer Data Privacy
- System Reliability
- Public & Employee Safety, Disaster Recovery





Gas Pipeline Risks

Some Regulatory questions:

- What is the value of reducing from 7.6 to 7.3, or from 8.6 to 6.4?
- What is the value of the next increment of reduction?
- How can we compare this with other IOU algorithms?
- How does this translate into spending authorizations?
- How subjective are these assessments?
- Can they be improved with better data?
- What is our (society's) risk tolerance?
- Is this really the best approach?





Limitations of Relative Risk Scoring

- Relative risk scoring can be useful for prioritizing risks and informing the decision-making process.
- However, it does not define a methodology for optimized risk mitigation.
- Different utilities use different formulas – how do we compare?

SED expects that through the SMAP and RAMP process, IOU risk management will gain additional maturity, improvements in data collection capability, data quality, and use of probabilistic models.

The long-term result is that the utilities and the Commission will eventually migrate to an expanded quantitative risk assessment approach.





Areas of Possible Research

- How to add confidence to subjective analysis of mitigations effectiveness?
- Benchmarking of risks, California IOUs v. industry cohorts.
- Performance metrics – PHMSA has metrics; are they useful for risk analysis?
- Probabilities of various equipment and component failures.
- Do differences in maintenance programs influence how often equipment fails?
- How do you really measure Safety improvements?
- Incentives versus compliance penalties.





Thank You!

**For further information related to A.15-02-002, et al.,
please contact :**

**Arthur O'Donnell
ao1@cpuc.ca.gov**

415-703-1184

